U.S. Department
of Transportation

**Federal Aviation
Administration**

Office of Airport Safety and Standards
Airport Engineering Division

800 Independence Ave., SW
Washington, DC 20591

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The attached is draft Change 17 to Advisory Circular (AC) 150/5370-10A STANDARDS FOR SPECIFYING CONSTRUCTION OF AIRPORTS. The purpose of this change is to incorporate improvement into the specification. The Airports Consultants Council (ACC), through their Engineering Committee has compiled a list of recommended updates to Item P-401 Plant Mix Bituminous Pavements. The updates are consistent with routine additions made by ACC members as part of construction project administration. This change also incorporates longstanding modifications approved for the Northwest Mountain and Central Regions as well as information from Unified Facilities Guide Specification (UFGS) 02749, used by the U.S. Department of Defense.

The principal changes are noted by marks in the border of each page. A pay factor has been added for joint density, separate acceptance criteria for surface and base course material has been added, and smoothness criteria has been added as an option.

This draft is available on the following Federal Aviation Administration internet website: http://www.faa.gov/arp/publications/acs/draftacs.cfm

Comments received no later than September 8, 2003, will be considered for inclusion in the final advisory circular.

Sincerely,

Rick Marinelli

Rick Marinelli
Manager, Airport Engineering Division

Attachment

ITEM P-401 PLANT MIX BITUMINOUS PAVEMENTS

DESCRIPTION

401-1.1 This item shall consist of *pavement* courses composed of mineral aggregate and bituminous material mixed in a central mixing plant and placed on a prepared course in accordance with these specifications and shall conform to the lines, grades, thicknesses, and typical cross sections shown on the plans. Each course shall be constructed to the depth, typical section, and elevation required by the plans and shall be rolled, finished, and approved before the placement of the next course.

* *

This specification is primarily intended to be used for *the surface course, base course, and leveling course for airfield flexible* pavements subject to aircraft loadings *of gross weights greater than 12,500 pounds (5,226 kg) and is to apply within the limits of the pavement designed for full load bearing capacity*.

The dimensions and depth of the "surface course" for which this specification applies shall be that as is defined by the Engineer's pavement design as performed in accordance with FAA Advisory Circular 150/5320-6, current edition .

* *

MATERIALS

401-2.1 AGGREGATE. Aggregates shall consist of crushed stone, crushed gravel, or crushed slag with or without ***natural*** sand or other inert finely divided mineral aggregate. The portion of materials retained on the No. 4 sieve is coarse aggregate. The portion passing the No. 4 (4.75 mm) sieve and retained on the No. 200 (0.075 mm) sieve is fine aggregate, and the portion passing the No. 200 (0.075 mm) sieve is mineral filler.

a. Coarse Aggregate. Coarse aggregate shall consist of sound, tough, durable particles, free from adherent films of matter that would prevent thorough coating and bonding with the bituminous material and be free from organic matter and other deleterious substances. The percentage of wear shall not be greater than ***40*** percent when tested in accordance with ASTM C 131. The sodium sulfate soundness loss shall not exceed ***10***percent, or the magnesium sulfate soundness loss shall not exceed ***13*** percent, after five cycles, when tested in accordance with ASTM C 88.

* *

Aggregates with a higher percentage loss *of* wear *or soundness* may be specified *in lieu of those above*, provided a satisfactory service record under similar conditions of service and exposure *has* been demonstrated.

* *

Aggregate shall contain at least **[ ]** percent by weight of individual pieces having two or more fractured faces and **[ ]** percent by weight having at least one fractured face. The area of each face shall be equal to at least 75 percent of the smallest midsectional area of the piece. When two fractured faces are contiguous, the angle between the planes of fractures shall be at least 30 degrees to count as two fractured faces. Fractured faces shall be obtained by crushing.

The aggregate shall not contain more than a total of 20 percent, by weight, of flat particles, elongated particles, and flat and elongated particles, , when tested in accordance with ASTM D 4791 with a value of 3:1.

Slag shall be air-cooled, blast furnace slag, and shall have a compacted weight of not less than 70 pounds per cubic foot (1.12 mg/cubic meter) when tested in accordance with ASTM C 29.

* *

For pavements designed for aircraft gross weights of 60,000 pounds (27 200 kg) or more, the Engineer shall specify 70 percent for two fractured faces and 85 percent for one fractured face. For pavements designed for aircraft gross weights less than 60,000 pounds (27 200 kg), the Engineer shall specify 50 percent for two fractured faces and 65 percent for one fractured face.

In areas where slag is not available or desired, the references to it should be deleted from all aggregate paragraphs.

* *

b. Fine Aggregate. Fine aggregate shall consist of clean, sound, durable, angular shaped particles produced by crushing stone, slag, or gravel that meets the requirements for wear and soundness specified for coarse aggregate. The aggregate particles shall be free from coatings of clay, silt, or other objectionable matter and shall contain no clay balls. The fine aggregate, including any blended material for the fine aggregate, shall have a plasticity index of not more than 6 and a liquid limit of not more than 25 when tested in accordance with ASTM D 4318.

Natural (nonmanufactured) sand may be used to obtain the gradation of the aggregate blend or to improve the workability of the mix. The amount of sand to be added will be adjusted to produce mixtures conforming to requirements of this specification. [The fine aggregate shall not contain more than 15 percent natural sand by weight of total aggregates.] If used, the natural sand shall meet the requirements of ASTM D 1073 and shall have a plasticity index of not more than 6 and a liquid limit of not more than 25 when tested in accordance with ASTM D 4318.

The aggregate shall have sand equivalent values of ***[45]*** or greater when tested in accordance with ASTM D 2419.

* *

Typically the sand equivalent value should be 45, unless local conditions require lower value.

The addition of natural sand to a mix containing all crushed coarse and fine aggregates will normally increase its workability and compactability. However, the addition of excessive amounts of natural sand tends to decrease the stability of the mixture. The requirement for a sand equivalent value of 45 usually limits the use of natural sand, however, the maximum of 15 percent natural sand may be included for locations where low stabilities are a chronic problem.

* *

c. Sampling. ASTM D 75 shall be used in sampling coarse and fine aggregate, and ASTM C 183 shall be used in sampling mineral filler.

401-2.2 MINERAL FILLER. If filler, in addition to that naturally present in the aggregate, is necessary, it shall meet the requirements of ASTM D 242.

401-2.3 BITUMINOUS MATERIAL. Bituminous material shall conform to the following requirements: **[ ]**.

* *

Asphalt cement binder shall conform to [AASHTO MP1 Performance Grade (PG) [_____]] [ASTM D 3381 Table 2, Viscosity Grade [ASTM D 946 Penetration Grade [_____]]. Test data indicating grade

certification shall be provided by the supplier at the time of delivery of each load to the mix plant. Copies of these certifications shall be submitted to the Engineer. The Engineer shall specify the grade and ASTM specification of bituminous material, based on geographical location and climatic conditions. Table VI-1, Selecting Asphalt Grade, contained in the Asphalt Institute's Manual Series-1 (MS-1) provides guidance on the selection of asphalt type. For cold climates, Table 2 of ASTM D 3381 may be specified to minimize the susceptibility for thermal cracking. Other specifications to minimize cracking, such as the addition of Penetration Index, Pen-Vis number, or Performance-Graded asphalts (PG-asphalt binders) can also be specified. The Engineer should be aware that PG asphalt binders may contain modifiers *that require* elevated mixing and compaction temperatures that exceed the temperatures specified in Item P-401.
Grades of some materials are listed below:

NOTE: Performance Graded (PG) d asphalt binders should be specified wherever available. The same grade PG binder used by the state highway department in the area should be considered as the base grade for the project (e.g. the grade typically specified in that specific location for dense graded mixes on highways with design ESALS less than 10 million). The exception would be that grades with a low temperature higher than PG XX-22 should not be used (e.g. PG XX-16 or PG XX-10), unless the Engineer has had successful experience with them. Typically, rutting is not a problem on airport runways. However, at airports with a history of stacking on end of runways and taxiway areas,rutting has accrued due to the slow speed of loading on the pavement. If there has been rutting on the project or it is anticipated that stacking may accrue during the design life of the project, then the following grade "bumping" should be applied for the top 125 mm (5 inches) of paving in the end of runway and taxiway areas: for aircraft tire pressure between 100 and 200 psi, increase the high temperature one grade; for aircraft tire pressure greater than 200 psi, increase the high temperature two grades. Each grade adjustment is 6 degrees C. Polymer Modified Asphalt, PMA, has shown to perform very well in these areas. The low temperature grade should remain the same. The Engineer may lower the low temperature grade to comply with the recommendations of the FHWA's software program "LTPPBind", if it is believed to be appropriate. Additional grade bumping and grade selection information is given in Table A. .

Table A. Binder Grade Selection and Grade Bumping Based on Gross Aircraft Weight.

Determine binder requirements from LTTP Bind version 2.1 using 98 percent reliability with no traffic or speed adjustments. Increase the high temperature grade by the number of grade equivalents indicated (1 grade is equivalent to 6 degrees C) below. Use the low temperature grade as determined from LTTP Bind version 2.1. (see NOTES)		
Aircraft Gross Weight (pounds)	High Temperature Adjustment to Binder Grade	
	Pavement Type	
	Runway	Taxiway/Apron
Less than 12,500	--	--
Less than 60,000	--	1
Less than 100,000	--	1
Greater than 100,000	*1*	2

NOTES:
1. PG grades above a –22 on the low end (e.g. 64–16) are not recommended. Limited experience has shown this to be a poor performer.
2. PG grades below a 64 on the high end (e.g. 58-22) are not recommended. These binders often provide tender tendencies.
3. PG grades above a 76 on the high end (e.g. 82-22) are not recommended. These binders anr very stiff and difficult to work and compact.

Grade Specification			
Penetration Grade ASTM D 946	Viscosity Grade ASTM D 3381		Performance Graded Asphalt Institte Superpave Series No. 1(SP-1)
40-50 60-70 85-100 100-120 120-150	AC-5 AC-10 AC-15 AC-20 AC-30 AC-40	AR-1000 AR-2000 AR-4000 AR-8000	In general, the Engineer should chose a PG-asphalt binder that has been approved for use in the vicinity by the State DOT, and is locally available. In general, a high reliability (98 percent) on both the high and low temperature categories is sufficiently conservative.

* *

The Contractor shall furnish vendor's certified test reports for each lot of bituminous material shipped to the project. The vendor's certified test report for the bituminous material can be used for acceptance or tested independently by the Engineer.

401-2.4 PRELIMINARY MATERIAL ACCEPTANCE. Prior to delivery of materials to the job site, the Contractor shall submit certified test reports to the Engineer for the following materials:

a. Coarse Aggregate.

(1) Percent of wear.
(2) Soundness.
(3) Unit weight of slag.

b. Fine Aggregate.

(1) Liquid limit.
(2) Plastic***ity*** index.
(3) Sand equivalent.

c. Mineral Filler.

d. Bituminous Material. Test results for bituminous material shall include temperature/viscosity charts for mixing and compaction temperatures.

The certification(s) shall show the appropriate ASTM test(s) for each material, the test results, and a statement that the material meets the specification requirement**.**

The Engineer may request samples for testing, prior to and during production, to verify the quality of the materials and to ensure conformance with the applicable specifications.

401-2.5 ANTI-STRIPPING AGENT. Any anti-stripping agent or additive if required shall be heat stable, shall not change the asphalt cement viscosity beyond specifications, shall contain no harmful ingredients, shall be added in recommended proportion by approved method, and shall be a material approved by the Department of Transportation of the State in which the project is located.

COMPOSITION

401-3.1 COMPOSITION OF MIXTURE. The bituminous plant mix shall be composed of a mixture of well-graded aggregate, filler ***and anti-strip agent*** if required, and bituminous material. The several aggregate fractions shall be sized, handled in separate size groups, and combined in such proportions that the resulting mixture meets the grading requirements of the job mix formula (JMF).

401-3.2 JOB MIX FORMULA. No bituminous mixture for payment shall be produced until a job mix formula has been approved **in writing** by the Engineer. The bituminous mixture shall be designed using procedures contained in Chapter **5**, MARSHALL METHOD OF MIX DESIGN, of the Asphalt Institute's Manual Series No. 2 (MS-2), Mix Design Methods for Asphalt Concrete, sixth edition, and shall meet the requirements of Tables 1, 2 and 3.

* *

Engineer may specify the FAA Eastern Region Laboratory Procedures Manual (ERLPM), Section 2 in lieu of MS-2.

* *

The design criteria in Table 1 are target values necessary to meet the acceptance requirements contained in paragraph 401-5.2b. The criteria is based on a production process which has a material variability with the following standard deviations:

Stability (lbs.) = 270
Flow (0.01 inch) = 1.5
Air Voids (%) = 0.65

If material variability exceeds the standard deviations indicated, the job mix formula and subsequent production targets ***shall*** be based on a stability greater than shown in Table 1, and the flow and air voids ***shall*** be targeted close to the mid-range of the criteria in order ***to*** meet the acceptance requirements.

Tensile Strength Ratio (TSR) of the composite mixture, as determined by ASTM D 4867, shall not be less than 75, nor shall the dry strength be less than 200 psi as determined by ASTM D1074. Anti-stripping agent shall be added to the asphalt, as necessary, to produce a TSR of not less than 75 while maintaining a minimum dry strength of 200 psi.. If an antistrip agent is required, it will be provided by the Contractor at no additional cost to the Owner.

The job mix formula shall be submitted in writing by the Contractor to the Engineer at least **[ ]** days prior to the start of paving operations and shall include as a minimum:

a. Percent passing each sieve size for total combined gradation, individual gradation of all aggregate stockpiles and percent by weight of each stockpile used in the job mix formula.

b. Percent of asphalt cement.

c. Asphalt viscosity or penetration grade.

d. Number of blows of hammer compaction per side of molded specimen.

e. Mixing temperature.

f. Compaction temperature.

g. Temperature of mix when discharged from the mixer.

h. Temperature-viscosity relationship of the asphalt cement.

I. Plot of the combined gradation on the Federal Highway Administration (FHWA) 45 power gradation curve.

j. Graphical plots of stability, flow, air voids, voids in the mineral aggregate, and unit weight ***versus*** asphalt content.

k. Percent natural sand.
l. Percent fractured faces.

m. Percent by weight of flat particles, elongated particles**,** and flat and elongated particles.

n. Tensile Strength Ratio (TSR).

o. Dry strength

p. Antistrip agent (if required).

The Contractor shall submit to the Engineer the results of verification testing of three (3) asphalt samples prepared at the optimum asphalt content. The average of the results of this testing shall indicate conformance with the job mix formula requirements specified in Tables 1, 2 and 3.

When the project requires asphalt mixtures of differing aggregate gradations, a separate job mix formula and the results of job mix formula verification testing must be submitted for each mix.

The job mix formula for each mixture shall be in effect until modified in writing by the Engineer. Should a change in sources of materials be made, a new job mix formula must be submitted within **[ ]** days and approved by the Engineer in writing before the new material is used. After the initial production job mix formula(s) has/have been approved by the Engineer and a new or modified job mix formula is required for whatever reason, the subsequent cost of the Engineer's approval of the new or modified job mix formula will be borne by the Contractor. There will be no time extension given or considerations for extra costs associated with the stoppage of production paving or restart of production paving due to the time needed for the Engineer to approve the initial, new or modified job mix formula.

* *

Engineer shall specify the number of days. A minimum of 10 days is recommended.

The Marshall Design Criteria applicable to a project shall be specified by the Engineer from the information shown below and inserted into Table 1. Asterisks denote insert points.

	Pavements Designed for Aircraft Gross Weights of	**Pavements Designed for Aircraft Gross Weights Less**

Test Property	60,000 Lbs. or More or Tire Pressures of 100 Psi or More	Than 60,000 Lbs. or Tire Pressures Less Than 100 Psi
Number of Blows	75	50
Stability, pounds (newtons)	2150 (9555)	1350 (4450)
Flow, 0.01 in. (0.25 mm)	10-14	10-18
Air Voids (percent)	2.8-4.2	2.8-4.2
Percent Voids in Mineral Aggregate (minimum)	See Table 2	See Table 2

****

TABLE 1. MARSHALL DESIGN CRITERIA

TEST PROPERTY	*
Number of blows	*
Stability, pounds (newtons) minimum	*
(newtons) minimum	
Flow, 0.01 in. (0.25 mm)	*
Air voids (percent)	*
Percent voids in mineral aggregate, minimum	

TABLE 2. MINIMUM PERCENT VOIDS IN MINERAL AGGREGATE

Maximum Particle Size		Minimum Voids in Mineral Aggregate, percent
in.	mm	Percent
1/2	12.5	16
3/4	19.0	15
1	25.0	14
1-1/4	31.25	13

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Modifications to the minimum VMA as found in Table 2 may be made depending on the definition of maximum particle size and/or local conditions.

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The mineral aggregate shall be of such size that the percentage composition by weight, as determined by laboratory ***sieves*** will conform to the gradation or gradations specified in Table 3 when tested in accordance with ASTM C 136 and C 117.

The gradations in Table 3 represent the limits which shall determine the suitability of aggregate for use from the sources of supply. The aggregate, as selected (and used in the JMF), shall have a gradation within the limits designated in Table 3 and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve, or vice versa, but shall be well graded from coarse to fine.

Deviations from the final approved mix design for bitumen content and gradation of aggregates shall be within the action limits for individual measurements as specified in paragraph 401-6.5a. The limits still will apply if they fall outside the master grading band in Table 3.

The maximum size aggregate used shall not be more than one-half of the thickness of the course being constructed except where otherwise shown on the plans or ordered by the Engineer.

TABLE 3. AGGREGATE - BITUMINOUS PAVEMENTS

Sieve Size	Percentage by Weight Passing Sieve
1 in. (25.0 mm)	*
3/4 in. (19.0 mm)	*
½ in. (12.5 mm)	*
3/8 in. (9.5 mm)	*
No. 4 (4.75 mm)	*
No. 8 (2.36 mm)	*
No. 16 (1.18 mm)	*
No. 30 (0.60 mm)	*
No. 50 (0.30 mm)	*
No. 100 (0.15 mm)	*
No. 200 (0.075 mm)	*
Asphalt percent	
Stone or gravel	*
Slag	*

The aggregate gradations shown are based on aggregates of uniform specific gravity. The percentages passing the various sieves shall be corrected when aggregates of varying specific gravities are used, as indicated in the Asphalt Institute Manual Series No. 2 (MS-2), Chapter 3.

* *

The aggregate gradation shall be specified by the Engineer from the gradations shown in this note. The gradation shall be inserted into Table 3. Asterisks denote insert points.

Where locally-available aggregates cannot be economically blended to meet the grading requirements of the gradations shown, the gradations may be modified to fit the characteristics of such local aggregates with approval of the FAA. The modified gradation must produce a paving mixture that satisfies the mix design requirements.

AGGREGATE - BITUMINOUS PAVEMENTS				
Sieve Size	Percentage by Weight Passing Sieves			
	1-1/4"max	1"max	3/4"max	1/2"max
1-1/4 in. (30.0 mm)	100	--	--	--
1 in. (24.0 mm)	86-98	100	--	--
3/4 in. (19.0 mm)	68-93	76-98	100	--
1/2 in. (12.5 mm)	57-81	66-86	79-99	100
3/8 in. (9.5 mm)	49-69	57-77	68-88	79-99
No. 4 (4.75 mm)	34-54	40-60	48-68	58-78
No. 8 (2.36 mm)	22-42	26-46	33-53	39-59
No. 16 (1.18 mm)	13-33	17-37	20-40	26-46
No. 30 (0.600 mm)	8-24	11-27	14-30	19-35
No. 50 (0.300 mm)	6-18	7-19	9-21	12-24
No. 100 (0.150 mm)	4-12	6-16	6-16	7-17
No. 200 (0.075 mm)	3-6	3-6	3-6	3-6
Asphalt percent:				
Stone or gravel	4.5-7.0	4.5-7.0	5.0-7.5	5.5-8.0
Slag	5.0-7.5	5.0-7.5	6.5-9.5	7.0-10.5

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/401-3.3 RECYCLED ASPHALT CONCRETE.

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NOTE: Reclaimed Asphalt Pavement (RAP) should not be used for surface mixes, except on shoulders. It can be used very effectively in lower layers, or for shoulders. Engineer to specify the maximum percentage of reclaimed asphalt allowed in the mix. The amount of RAP shall be limited to 30 percent, as long as the resulting recycled mix meets all requirements that are specified for virgin mixtures. The Contractor may obtain the RAP from the job site or an existing source.

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Recycled HMA shall consist of reclaimed asphalt pavement (RAP), coarse aggregate, fine aggregate, mineral filler, and asphalt cement. The RAP shall be of a consistent gradation and asphalt content and properties. When RAP is fed into the plant, the maximum RAP chunk size shall not exceed 2 inches. The recycled HMA mix shall be designed using procedures contained in AI MS-02. The recycled asphalt concrete mix shall be designed using procedures contained in the Asphalt Institute's Manual Series Number 2 (MS-2). The percentage of asphalt in the RAP shall be established for the mixture design according to ASTM D 2172 using the appropriate dust correction procedure. The job mix shall meet the requirements of paragraph 401-3.2 RAP should only be used for shoulder surface course mixes and for any intermediate courses. The amount of RAP shall be limited to **[30 percent]**.

In addition to the requirements of paragraph 401-3.2, the job mix formula shall indicate the percent of reclaimed asphalt pavement and the percent and viscosity grade of new asphalt. The Contractor shall submit documentation to the Engineer, indicating that the mixing equipment proposed for use is adequate to mix the percent of RAP shown in the job mix formula and meet all local and national environmental regulations.

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NOTE: The appropriate test should be selected to conform to the grade of new asphalt specified. If a penetration grade is specified, use penetration test. If a viscosity grade is specified, use a viscosity test. If a PG asphalt binder is specified, use the dynamic shear rheometer and bending beam tests.

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The blend of new asphalt cement and the RAP asphalt binder shall meet the requirements in paragraph 401-2.3 The virgin asphalt cement shall not be more than two standard asphalt material grades different than that specified in paragraph 401-2.3

* *

Delete *paragraph 401-3.3 in its entirety* if recycled asphalt pavement is not to be allowed and include a sentence that RAP will not be permitted to be used.

* *

401-3.4 TEST SECTION. Prior to full production, the Contractor shall prepare and place a quantity of bituminous mixture according to the job mix formula. The amount of mixture ***shall*** be sufficient to construct a test section **[ ]** long and **[ ]** wide**,** placed in two lanes, with a longitudinal cold joint, and shall be of the same depth specified for the construction of the course which it represents. A cold joint is an exposed construction joint at least 4 hours old or whose mat has cooled to less than 160^0 F. The underlying grade or pavement structure upon which the test section is to be constructed shall be the same as the remainder of the course represented by the test section. The equipment used in construction of the test section shall be the same type and weight to be used on the remainder of the course represented by the test section.

The test section shall be evaluated for acceptance as a single lot in accordance with the acceptance criteria in paragraph 401-5.1 and 401-6.3. As a minimum the test section shall consist of 3 sublots.

* *

Engineer may also specify the Eastern Region Laboratory Procedures Manual (ERLPM), Section 2 in lieu of MS-2.

* *

The test section shall be considered acceptable if; 1) stability, flow, mat density, air voids, and joint density are 90 percent or more within limits, 2) gradation and asphalt content are within the action limits specified in paragraphs 401-6.5a and 5b, and 3) the voids in the mineral aggregate ***are*** within the limits of Table 2. If the initial test section should prove to be unacceptable, the necessary adjustments to the job mix formula, plant operation, placing procedures, and/or rolling procedures shall be made. A second test section shall then be placed. If the second test section also does not meet specification requirements, both sections shall be removed at the Contractor's expense. Additional test sections, as required, shall be constructed and evaluated for conformance to the specifications. Any additional sections that are not acceptable shall be removed at the Contractor's expense. Full production shall not begin until an acceptable section has been constructed and accepted ***in writing*** by the Engineer. No payment will be made for any test section that does not meet all parameters specified in paragraph 401-5.2. Once the Engineer has determined that a test section does meet all required parameters, payment for the initial test section, and any subsequent section that meets specification requirements shall be made in accordance with paragraph 401-8.1.

Job mix control testing shall be performed by the Contractor at the start of plant production and in conjunction with the calibration of the plant for the job mix formula. If aggregates produced by the plant do not satisfy the gradation requirements or produce a mix that meets the JMF, it will be necessary to reevaluate and redesign the mix using plant-produced aggregates. Specimens ***shall*** be prepared and the optimum bitumen content determined in the same manner as for the original design tests.

* *

The test section should be a minimum of 300 feet (90 m) long and 20 to 30 feet (6 to 9 m) wide. The test section affords the Contractor and the Engineer an opportunity to determine the quality of the mixture in place, as well as performance of the plant and laydown equipment.

Until the plant is *consistently* producing the desired mix, frequent testing may be necessary.

* *

Contractor will not be allowed to place the test section until the Contractor's Quality Control Program, showing conformance with the requirements of Paragraph 401-6.1, has been approved, in writing, by the Engineer.

401-3.5 TESTING LABORATORY. The Contractor's laboratory used to develop the job mix formula shall meet the requirements of ASTM D 3666. A certification signed by the manager of the laboratory stating that it meets these requirements shall be submitted to the Engineer prior to the start of construction.

CONSTRUCTION METHODS

401-4.1 WEATHER LIMITATIONS. The bituminous mixture shall not be placed upon a wet surface or when the surface temperature of the underlying course is less than specified in Table 4. The temperature requirements may be waived by the Engineer, if requested; however, all other requirements including compaction shall be met.

TABLE 4. BASE TEMPERATURE LIMITATIONS

Mat Thickness	Base Temperature (Minimum)	
	Deg. F	Deg. C
3 in. (7.5 cm) or greater	40	4
Greater than 1 in. (2.5 cm) but less than 3 in. (7.5 cm)	45	7
1 in. (2.5 cm) or less	50	10

401-4.2 BITUMINOUS MIXING PLANT. Plants used for the preparation of bituminous mixtures shall conform to the requirements of ASTM D 995 with the following changes:

a. Requirements for All Plants.

(1) Truck Scales. The bituminous mixture shall be weighed on approved scales furnished by the Contractor, or on certified public scales at the Contractor's expense. Scales shall be inspected and sealed as often as the Engineer deems necessary to assure their accuracy. Scales shall conform to the requirements of the General Provisions, Section 90-01.

In lieu of scales, and as approved by the Engineer, asphalt mixture weights may be determined by the use of an electronic weighing system equipped with an automatic printer which weighs the total paving mixture. Contractor must furnish calibration certification of the weighing system prior to mix production and as often thereafter as requested by the Engineer.

(2) Testing Facilities. The Contractor shall provide laboratory facilities at the plant for the use of the Engineer's acceptance testing and the Contractor's quality control testing. The Engineer will always have priority in the use of the laboratory. The lab shall have sufficient space and equipment so that both testing representatives (Engineer's and Contractor's) can operate efficiently. The lab shall also meet the requirements of ASTM D 3666.

The plant testing laboratory shall have a floor space area of not less than 150 square feet, with a ceiling height of not less than 7-1/2 feet. The laboratory shall be weather tight, sufficiently heated in cold weather, air-conditioned in hot

weather to maintain temperatures for testing purposes of 70 degrees F +/- 5 degrees F. The plant testing laboratory shall be located on the plant site to provide an unobstructed view, from one of its windows, of the trucks being loaded with the plant mix materials.

Laboratory facilities shall be kept clean, and all equipment shall be maintained in proper working condition. The Engineer shall be permitted unrestricted access to inspect the Contractor's laboratory facility and witness quality control activities. The Engineer will advise the Contractor in writing of any noted deficiencies concerning the laboratory facility, equipment, supplies, or testing personnel and procedures. When the deficiencies are serious enough to be adversely affecting the test results, the incorporation of the materials into the work shall be suspended immediately and will not be permitted to resume until the deficiencies are satisfactorily corrected.

As a minimum, the plant testing laboratory shall have:

(a) Adequate artificial lighting
(b) Electrical outlets sufficient in number and capacity for operating the required testing equipment and drying samples.
(c) Fire extinguishers (2), Underwriter's approved
(d) Work benches for testing, minimum 2-1/2 feet by 10 feet.
(e) Desk with 2 chairs
(f) Sanitary facilities convenient to testing laboratory
(g) Exhaust fan to outside air, minimum 12 inch blade diameter
(h) A direct telephone line and telephone including a FAX machine operating 24 hours per day, seven days per week
(i) File cabinet with lock for Engineer
(j) Sink with running water, attached drain board and drain capable of handling separate material
(k) Metal stand for holding washing sieves
(l) Two element hot plate or other comparable heating device, with dial type thermostatic controls for drying aggregates
(m) Mechanical shaker and appropriate sieves (listed in JMF, Table 3) meeting the requirements of ASTM E-11 for determining the gradation of coarse and fine aggregates in accordance with ASTM C 136
(n) Marshall testing equipment meeting ASTM D 1559, automatic compaction equipment capable of compacting three specimens at once and other apparatus as specified in ASTM C 127, D 2172, D 2726, and D 2041
(o) Oven, thermostatically controlled, inside minimum 1 cubic foot
(p) Two volumetric specific gravity flasks, 500 cc
(q) Other necessary hand tools required for sampling and testing
(r) Library containing contract specifications, latest ASTM volumes 4.01, 4.02,4.03 and 4.09, AASHTO standard specification parts I and II, and Asphalt Institute Publication MS-2.
(s) Equipment for Theoretical Specific Gravity testing including a 4,000 cc pycnometer, vacuum pump capable of maintaining 30 ml mercury pressure and a balance, 16-20 kilograms with accuracy of 0.5 grams
(t) Extraction equipment, centrifuge and reflux types and ROTOflex equipment
(u) A masonry saw with diamond blade for trimming pavement cores and samples
(v) Telephone

Approval of the plant and testing laboratory by the Engineer requires all facilities and equipment to be in good working order during production, sampling and testing. Failure to provide the specified facilities shall be sufficient cause for disapproving bituminous plant operations.

The Owner shall have access to the lab and the plant whenever Contractor is in production.

(3) Inspection of Plant. The Engineer, or Engineer's authorized representative, shall have access, at all times, to all areas of the plant for checking adequacy of equipment; inspecting operation of the plant: verifying weights, proportions, and material properties; and checking the temperatures maintained in the preparation of the mixtures.

(4) Storage Bins and Surge Bins. Use of surge ***and*** storage bins for temporary storage of hot bituminous mixtures will be permitted as follows:

(a) The bituminous mixture may be stored in surge bins for ***a*** period of time not to exceed 3 hours.

(b) The bituminous mixture may be stored in insulated storage bins for a period of time not to exceed 24 hours**.**

The bins shall be such that mix drawn from them meets the same requirements as mix loaded directly into trucks.

If the Engineer determines that there is an excessive amount of heat loss, segregation**,** or oxidation of the mixture due to temporary storage, no ***temporary*** storage will be allowed.

401-4.3 HAULING EQUIPMENT. Trucks used for hauling bituminous mixtures shall have tight, clean, and smooth metal beds. To prevent the mixture from adhering to them, the truck beds shall be lightly coated with a minimum amount of paraffin oil, lime solution, or other approved material. Petroleum products shall not be used for coating truck beds. Each truck shall have a suitable cover to protect the mixture from adverse weather. When necessary, to ensure that the mixture will be delivered to the site at the specified temperature, truck beds shall be insulated or heated and covers shall be securely fastened.

401-4.4 BITUMINOUS PAVERS. Bituminous pavers shall be self-propelled with an activated heated screed, capable ***of*** spreading and finishing courses of bituminous plant mix material which will meet the specified thickness, smoothness, and grade. The paver shall have sufficient power to propel itself and the hauling equipment without adversely affecting the finished surface.

The paver shall have a receiving hopper of sufficient capacity to permit a uniform spreading operation. The hopper shall be equipped with a distribution system to place the mixture uniformly in front of the screed without segregation. The screed shall effectively produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture.

The paver shall be equipped with a control system capable of automatically maintaining the specified screed elevation. The control system shall be automatically actuated from either a reference line and/or through a system of mechanical sensors or sensor-directed mechanisms or devices which will maintain the paver screed at a predetermined transverse slope and at the proper elevation to obtain the required surface. The transverse slope controller shall be capable of maintaining the screed at the desired slope within plus or minus 0.1 percent.

The controls shall be capable of working in conjunction with any of the following attachments:

a. Ski-type device of not less than 30 feet (9.14 m) in length.

b. Taut stringline (wire) set to grade.

c. Short ski or shoe.

d. Laser control.

If, during construction, it is found that the spreading and finishing equipment in use leaves tracks or indented areas, or produces other blemishes in the pavement that are not satisfactorily corrected by the scheduled operations, the use of such equipment shall be discontinued and satisfactory equipment shall be provided by the Contractor**.**

401-4.5 ROLLERS. Rollers of the vibratory, steel wheel, and pneumatic-tired type shall be used. They shall be in good condition, capable of operating at slow speeds to avoid displacement of the bituminous mixture. The number, type, and weight of rollers shall be sufficient to compact the mixture to the required density while it is still in a workable condition.

All rollers shall be specifically designed and suitable for compacting hot mix bituminous concrete and shall be properly used. Rollers that impair the stability of any layer of a pavement structure or underlying soils shall not be used. Depressions in pavement surfaces caused by rollers shall be repaired by the Contractor at its own expense.

The use of equipment which causes crushing of the aggregate will not be permitted.

a. Nuclear Densometer. The Contractor shall have on site a nuclear densometer during all paving operations in order to assist in the determination of the optimum rolling pattern, type of roller and frequencies, as well as to monitor the effect of the rolling operations during production paving. The Contractor shall also supply a qualified technician during all paving operations to calibrate the nuclear densometer and obtain accurate density readings for all new bituminous concrete. These densities shall be supplied to the Engineer upon request at any time during construction. No separate payment will be made for supplying the density gauge and technician.

401-4.6 PREPARATION OF BITUMINOUS MATERIAL. The bituminous material shall be heated in a manner that will avoid local overheating and provide a continuous supply of the bituminous material to the mixer at a uniform temperature. The temperature of the bituminous material delivered to the mixer shall be sufficient to provide a suitable viscosity for adequate coating of the aggregate particles, but shall not exceed 325 degrees F (160 degrees C), unless otherwise required by the manufacturer.

401-4.7 PREPARATION OF MINERAL AGGREGATE. The aggregate for the mixture shall be heated and dried prior to introduction into the mixer. The maximum temperature and rate of heating shall be such that no damage occurs to the aggregates. The temperature of the aggregate and mineral filler shall not exceed 350 degrees F (175 degrees C) when the asphalt is added. Particular care shall be taken that aggregates high in calcium or magnesium content are not damaged by overheating. The temperature shall not be lower than is required to obtain complete coating and uniform distribution on the aggregate particles and to provide a mixture of satisfactory workability.

401-4.8 PREPARATION OF BITUMINOUS MIXTURE. The aggregates and the bituminous material shall be weighed or metered and introduced into the mixer in the amount specified by the job mix formula.

The combined materials shall be mixed until the aggregate obtains a uniform coating of bitumen and is thoroughly distributed throughout the mixture. Wet mixing time shall be the shortest time that will produce a satisfactory mixture, but not less than 25 seconds for batch plants. The wet mixing time for all plants shall be established by the Contractor, based on the procedure for determining the percentage of coated particles described in ASTM D 2489, for each individual plant and for each type of aggregate used. The wet mixing time will be set to achieve 95 percent of coated particles. For continuous mix plants, the minimum mixing time shall be determined by dividing the weight of its contents at operating level by the weight of the mixture delivered per second by the mixer. The moisture content of all bituminous mixtures upon discharge shall not exceed 0.5 percent.

* *

For batch plants, wet mixing time begins with the introduction of bituminous material into the mixer and ends with the opening of the mixer discharge gate. Distribution of aggregate and bituminous material as they enter the pugmill, speed of mixer shafts, and arrangement and pitch of paddles are factors governing efficiency of mixing. Prolonged exposure to air and heat in the pugmill harden the asphalt film on the aggregate. Mixing time, therefore, should be the shortest time required to obtain uniform distribution of aggregate sizes and thorough coating of aggregate particles with bituminous material.

* *

401-4.9 PREPARATION OF THE UNDERLYING SURFACE. Immediately before placing the bituminous mixture, the underlying course shall be cleaned of all dust and debris. A prime coat or tack coat shall be applied in accordance with Item P-602 or P-603, if required by the contract specifications.

* *

Engineer should evaluate the presence of paint and/or rubber deposits on the existing pavement and, if needed, may specify milling, grinding or other suitable means to remove same prior to placement of new bituminous material.

* *

401-4.10 TRANSPORTING, PLACING, AND FINISHING. Prior to the placement of the bituminous mixture, the Contractor shall prepare a laydown plan for approval by the Engineer. This is to minimize the number of cold joints in the pavement. The laydown plan shall include the sequence of paving laydown by stations, width of lanes, temporary ramp location(s), and laydown temperature. The laydown plan shall also include estimated time of completion for each portion of the work (i.e. milling, paving, rolling, cooling, etc.)

The bituminous mixture shall be transported from the mixing plant to the site in vehicles conforming to the requirements of paragraph 401-4.3. Deliveries shall be scheduled so that placing and compacting of mixture is uniform with minimum stopping and starting of the paver. Hauling over freshly placed material shall not be permitted until the material has been compacted, as specified, and allowed to cool to atmospheric temperature.

* *

Engineer may, at his option, add the following language:

"For all runway, taxiway and apron pavements, Contractor shall use a stringline to place each lane of each lift of bituminous surface course. However, at the Contractor's option, Contractor shall use stringline for first lift of bituminous surface course and then survey the grade of that lift. Provided grades of that lift of bituminous surface course meet the tolerances of paragraphs 401-5.2b(6), then Contractor may place successive lifts of bituminous surface course using a long ski, or laser control per paragraph 401-4.4. However, Contractor shall survey each lift of bituminous surface course and certify to Engineer that every lot of each lift meets the grade tolerances of paragraph 401-5.2b(6) before the next lift can be placed without a stringline. If the grades of a single lot do not meet the tolerances of 401-5.2b(6), then the Contractor shall use a stringline for each entire lift. Corrective action in paragraph 401-5.2b(6) applies to the final lift of surface course; however, Contractor shall correct next to final surface course lift to ensure that final lift of surface course is a minimum of [ ] inches and a maximum of [ ] inches." (Engineer to specify minimum and maximum tolerances for final lift of surface course)

* *

[The Contractor may elect to use a material transfer vehicle to deliver mix to the paver.]

* *

Use of a material transfer vehicle allows the paver to be operated almost continuously without stopping between truckloads of mix, if a continuous supply of mix is available from the asphalt plant.

* *

Paving during nighttime construction shall require the following:

a. All paving machines, rollers, distribution trucks and other vehicles required by the Contractor for his operations shall be equipped with artificial illumination sufficient to safely complete the work.

b. Minimum illumination level shall be twenty (20) horizontal foot candles and maintained in the following areas:

(1) An area of 30 feet wide by 30 feet long immediately behind the paving machines during the operations of the machines.

(2) An area 15 feet wide by 30 feet long immediately in front and back of all rolling equipment, during operation of the equipment.

(3) An area 15 feet wide by 15 feet long at any point where an area is being tack coated prior to the placement of pavement.

c. As partial fulfillment of the above requirements, the Contractor shall furnish and use, complete artificial lighting units with a minimum capacity of 3,000 watt electric beam lights, affixed to all equipment in such a way to direct illumination on the area under construction.

d. In addition, the Contractor shall furnish [ ] portable floodlight units similar or equal to [ ].

* *

Engineer to specify the minimum number of floodlighting units and may elect to specify a particular manufacturer's lighting unit "or equal".

If nighttime paving requires the critical re-opening of airfield facilities, the following additional language should be added:

"If the Contractor places any out of specification mix in the project work area, the Contractor is required to remove it at its own expense, to the satisfaction of the Engineer. If the Contractor has to continue placing non-payment bituminous concrete, as directed by the Engineer, to make the surfaces safe for aircraft operations, the Contractor shall do so to the satisfaction of the Engineer. It is the Contractor's responsibility to leave the facilities to be paved in a safe condition ready for aircraft operations. No consideration for extended closure time of the area being paved will be given. As a first order of work for the next paving shift, the Contractor shall remove all out of specification material and replace with approved material to the satisfaction of the Engineer. When the above situations occur, there

will be no consideration given for additional construction time or payment for extra costs."

* *

The initial placement and compaction of the mixture shall occur at a temperature suitable for obtaining density, surface smoothness, and other specified requirements but not less than 250 degrees F (107 degrees C).

Edges of existing bituminous pavement abutting the new work shall be saw cut and carefully removed as shown on the drawings and painted with bituminous tack coat before new material is placed against it.

Upon arrival, the mixture shall be placed to the full width by a bituminous paver. It shall be struck off in a uniform layer of such depth that, when the work is completed, it shall have the required thickness and conform to the grade and contour indicated. The speed of the paver shall be regulated to eliminate pulling and tearing of the bituminous mat. Unless otherwise permitted, placement of the mixture shall begin along the centerline of a crowned section or on the high side of areas with a one-way slope. The mixture shall be placed in consecutive adjacent strips having a minimum width of **[ ]** except where edge lanes require less width to complete the area. Additional screed sections shall not be attached to widen paver to meet the minimum lane width requirements specified above unless additional auger sections are added to match . The longitudinal joint in one course shall offset the longitudinal joint in the course immediately below by at least 1 foot (30 cm); however, the joint in the surface top course shall be at the centerline of crowned pavements. Transverse joints in one course shall be offset by at least 10 feet (3 m) from transverse joints in the previous course.

Transverse joints in adjacent lanes shall be offset a minimum of 10 feet (3 m).

On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impractical, the mixture may be spread and luted by hand tools.

* *

The Engineer should specify the widest paving lane practicable in an effort to hold the number of longitudinal joints to a minimum.

* *

401-4.11 COMPACTION OF MIXTURE. After placing, the mixture shall be thoroughly and uniformly compacted by power rollers. The surface shall be compacted as soon as possible when the mixture has attained sufficient stability so that the rolling does not cause undue displacement, cracking or shoving. The sequence of rolling operations and the type of rollers used shall be at the discretion of the Contractor. The speed of the roller shall, at all times, be sufficiently slow to avoid displacement of the hot mixture and be effective in compaction. Any displacement occurring as a result of reversing the direction of the roller, or from any other cause, shall be corrected at once.

Sufficient rollers shall be furnished to handle the output of the plant. Rolling shall continue until the surface is of uniform texture, true to grade and cross section, and the required field density is obtained.

To prevent adhesion of the mixture to the roller, the wheels shall be equipped with a scraper and kept properly moistened, but excessive water will not be permitted.

In areas not accessible to the roller, the mixture shall be thoroughly compacted with approved power driven tampers. Tampers shall weigh not less than 275 pounds, have a tamping plate width not less than 15 inches, be rated at not less than 4,200 vibrations per minute, and be suitably equipped with a standard tamping plate wetting device.

Any mixture that becomes loose and broken, mixed with dirt, contains check-cracking, or in any way defective shall be removed and replaced with fresh hot mixture and immediately compacted to conform to the surrounding area. This work shall be done at the Contractor's expense. Skin patching shall not be allowed.

401-4.12 JOINTS. The formation of all joints shall be made in such a manner as to ensure a continuous bond between the courses and obtain the required density. All joints shall have the same texture as other sections of the course and meet the requirements for smoothness and grade.

The roller shall not pass over the unprotected end of the freshly laid mixture except when necessary to form a transverse joint. When necessary to form a transverse joint, it shall be made by means of placing a bulkhead or by tapering the course. The tapered edge shall be cut back to its full depth and width on a straight line to expose a vertical face prior to placing the adjacent lane. In both methods, all contact surfaces shall be given a tack coat of bituminous material before placing any fresh mixture against the joint.

Longitudinal joints which are irregular, damaged, uncompacted, or otherwise defective [or which have been left exposed for more than 4 hours, or whose surface temperature has cooled to less than 160^0 F] shall be cut back to expose a clean, sound surface for the full depth of the course. All contact surfaces shall be given a tack coat of bituminous material prior to placing any fresh mixture against the joint. The cost of this work and tack coat shall be considered incidental to the cost of the bituminous course.

* *

Engineer may retain the bracketed language regarding the treatment of "cold joints" when considered necessary.

* *

401-4.13 SKID RESISTANT SURFACES. If shown on the plans, skid resistant surfaces for asphalt pavements shall be provided by construction of saw-cut grooves. Construction specifications are contained in FAA AC 150/5320-12, current edition.

MATERIAL ACCEPTANCE

401-5.1 ACCEPTANCE SAMPLING AND TESTING. Unless otherwise specified, all acceptance sampling and testing necessary to determine conformance with the requirements specified in this section will be performed by the Engineer at no cost to the Contractor except that coring [and profilograph testing] as required in this section shall be completed and paid for by the Contractor.. Testing organizations performing these tests [except profilograph] shall meet the requirements of ASTM D 3666. All equipment in Contractor furnished laboratories shall be calibrated by the testing organization prior to the start of operations.

* *

See note to Engineer in section 401-5.2b(5) regarding the use of profilograph testing. If this testing is specfied, it is performed and paid for by the Contractor.

* *

a. Plant-Produced Material. Plant-produced material shall be tested for stability, flow, and air voids on a lot basis. Sampling shall be from material deposited into trucks at the plant or from trucks at the job site. Samples shall be taken in accordance with ASTM D 979. A lot will consist of:

- one day or shift's production not to exceed 2,000 tons (1 814 000 kg), or

- a half day or shift's production where a day's production is expected to consist of between 2,000 and 4,000 tons (1 814 000 and 3 628 000 kg), or

- similar subdivisions for tonnages over 4,000 tons (3 628 000 kg).

Where more than one plant is simultaneously producing material for the job, the lot sizes shall apply separately for each plant.

(1) Sampling. Each lot will consist of four equal sublots. Sufficient material for preparation of test specimens for all testing will be sampled by the Engineer on a random basis, in accordance with the procedures contained in ASTM D 3665. One set of laboratory compacted specimens will be prepared for each sublot in accordance with ASTM D 1559, at the number of blows required by paragraph 401-3.2, Table 1. Each set of laboratory compacted specimens will consist of three test portions prepared from the same sample increment.

The sample of bituminous mixture may be put in a covered metal tin and placed in an oven for not less than 30 minutes nor more than 60 minutes to stabilize to compaction temperature. The compaction temperature of the specimens ***shall*** be as specified in the job mix formula.

(2) Testing. Sample specimens shall be tested for stability and flow in accordance with ASTM D 1559. Air voids will be determined by the Engineer in accordance with ASTM D 3203.

Prior to testing, the bulk specific gravity of each test specimen shall be measured by the Engineer in accordance with ASTM D 2726 using the procedure for laboratory-prepared thoroughly dry specimens, or ASTM D 1188, whichever is applicable, for use in computing air voids and pavement density.

For air voids determination, the theoretical maximum specific gravity of the mixture shall be measured twice for each sublot in accordance with ASTM D 2041, Type C, D or E container. The value used in the air voids computation for each sublot shall be based on the average of the two maximum specific gravity measurements for the sublot.

The stability and flow for each sublot shall be computed by averaging the results of all test specimens representing that sublot.

(3) Acceptance. Acceptance of plant produced material for stability, flow, and air voids shall be determined by the Engineer in accordance with the requirements of paragraph 401-5.2b.

b. Field Placed Material. Material placed in the field shall be tested for mat and joint density on a lot basis.

(1) Mat Density. The lot size shall be the same as that indicated in paragraph 401-5.1a and shall be divided into four equal sublots. One core of finished, compacted materials shall be taken by the Contractor from each sublot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D 3665. Cores shall not be taken closer than one foot from a transverse or longitudinal joint.

(2) Joint Density. The lot size shall be the total length of longitudinal joints constructed by a lot of material as defined in paragraph 401-5.1a. The lot shall be divided into four equal sublots. One core of finished, compacted materials shall be taken by the Contractor from each sublot. Core locations will be determined by the Engineer on a random basis in accordance with procedures contained in ASTM D 3665. ALL CORING SHALL BE CENTERED ON THE JOINT. The minimum core diameter for joint density determination shall be 5 inches

(3) Sampling. Samples shall be neatly cut with a core drill. The cutting edge of the core drill bit shall be of hardened steel or other suitable material with diamond chips embedded in the metal cutting edge. The minimum diameter of the sample shall be five inches. Samples that are clearly defective, as a result of sampling, shall be discarded and another sample taken. The Contractor shall furnish all tools, labor, and materials for cutting samples and filling the cored pavement. Cored holes shall be filled in a manner acceptable to the Engineer and within one day after sampling.

(4) Testing. The bulk specific gravity of each cored sample will be measured by the Engineer in accordance with ASTM D 2726 or ASTM D 1188, whichever is applicable. The percent compaction (density) of each sample will be determined by dividing the bulk specific gravity of each sublot sample by the average bulk specific gravity of all laboratory prepared specimens for the lot, as determined in paragraph 401-5.1a(2). The bulk specific gravity used to determine the joint density at joints between two different lots shall be the lower of the bulk specific gravity values from the two different lots.

(5) Acceptance. Acceptance of field placed material for mat density will be determined by the Engineer in accordance with the requirements of paragraph ***401-5.2b(1***). Acceptance for joint density will be determined in accordance with the requirements of paragraph ***401-5.2b(3)***.

c. Partial Lots — Plant-Produced Material. When operational conditions cause a lot to be terminated before the specified number of tests have been made for the lot, or when the Contractor and Engineer agree in writing to allow overages or other minor tonnage placements to be considered as partial lots, the following procedure will be used to adjust the lot size and the number of tests for the lot.

The last batch produced where production is halted will be sampled, and its properties shall be considered as representative of the particular sublot from which it was taken. Where three sublots are produced, they shall constitute a lot. Where one or two sublots are produced, they shall be incorporated into the next lot, and the total number of sublots shall be used in the acceptance plan calculation, i.e., n = 5 or n = 6, for example. Partial lots at the end of asphalt production on the project shall be included with the previous lot**.**

d. Partial Lots — Field Placed Material. The lot size for field placed material shall correspond to that of the plant material, except that, in no cases, sha*l**l*** less than three (3) cored samples be obtained, i.e., n = 3.

401-5.2 ACCEPTANCE CRITERIA.

a. General. Acceptance will be based on the following characteristics of the bituminous mixture and completed pavement as well as the implementation of the Contractor's Quality Control plan and test results:

(1) Stability
(2) Flow
(3) Air voids
(4) Mat density
(5) Joint density
(6) Thickness
(7) Smoothness
(8) Grade
[(9) Absence of Ponding]

* *

See note to Engineer in section 401-5.2b(7) regarding absence of ponding

* *

Mat density and air voids will be evaluated for acceptance in accordance with paragraph 401-5.2b(1). Stability and flow will be evaluated for acceptance in accordance with paragraph 401-5.2b(2). Joint density will be evaluated for acceptance in accordance with paragraph 401-5.2b(3).

Thickness will be evaluated by the Engineer for compliance in accordance with paragraph ***401-5.2b(4)*** Acceptance for smoothness will be based on the criteria contained in paragraph ***401-5.2b(5)***. Acceptance for grade will be based on the criteria contained in paragraph 401-5.2b(6) [Acceptance for the absence of ponding will be based on criteria contained in paragraph 401-5.2b(7) .]

* *

See note to Engineer in section 401-5.2b(7) regarding abscence of ponding

* *

The Engineer may at any time, notwithstanding previous plant acceptance, reject and require the Contractor to dispose of any batch of bituminous mixture which is rendered unfit for use due to contamination, segregation, incomplete coating of aggregate, or improper mix temperature. Such rejection may be based on only visual inspection or temperature measurements. In the event of such rejection, the Contractor may take a representative sample of the rejected material in the presence of the Engineer, and if it can be demonstrated in the laboratory, in the presence of the Engineer, that such material was erroneously rejected, payment will be made for the material at the contract unit price.

b. Acceptance Criteria.

(1) Mat Density and Air Voids. Acceptance of each lot of plant produced material for mat density and air voids shall be based on the percentage of material within specification limits (PWL). If the PWL of the lot equals or exceeds 90 percent, the lot shall be acceptable. Acceptance and payment shall be determined in accordance with paragraph 401-8.1.

(2) Stability and Flow. Acceptance of each lot of plant produced material for stability and flow shall be based on the percentage of material within specification limits (PWL). If the PWL of the lot equals or exceeds 90 percent, the lot shall be acceptable. If the PWL is less than 90 percent, the Contractor shall determine the reason and take corrective action. If the PWL is below 80 percent, the Contractor must stop production and make adjustments to the mix. Lots with PWL below 80 percent for stability or flow values shall be removed and replaced at the expense of the Contractor.

(3) Joint Density. Acceptance of each lot of plant produced material for joint density shall be based on the percentage of material within specification limits (PWL). If the PWL of the lot is equal to or exceeds 90 percent, the lot shall be considered acceptable. If the PWL is less than 90 percent, the Contractor shall evaluate the reason and act accordingly. If the PWL is less than 80 percent, the Contractor shall cease operations and until the reason for poor compaction has been determined. IF THE PWL IS LESS THAN 71 PERCENT, THE LOT PAY FACTOR FOR THE FIRST LOT USED TO COMPLETE THE JOINT SHALL BE REDUCED BY 5 PERCENTAGE POINTS. This lot pay factor reduction shall be incorporated and evaluated in accordance with paragraph 401-8.1.

(4) Thickness. Thickness of each lift of surface course shall be evaluated by the Engineer for compliance to the requirements shown on the plans. Measurements of thickness shall be made by the Engineer using the cores extracted for each sublot for density measurement. The maximum allowable defficiency at any point shall not be more than 1/4 inch less than the thickness indicated for the lift. Avergage thickness of lift, or combined lifts, shall not be less than the indicated thickness. Where the thickness exceeds the specified tolerances, the lot or sublot shall be corrected by the Contractor at his expense by removing the deficient area and replacing with new pavement. The Contractor, at his expense, may take additional cores as approved by the Engineer to circumscribe the deficient area.

(5) Smoothness. The final surface shall be free from roller marks. The finished surfaces of each course of the pavement, except the finished surface of the final course, shall not vary more than 3/8 inch when evaluated with a 16 foot straightedge. The finished surface of the final course of pavement shall not vary more than 1/4 inch when evaluated with a 16 foot straightedge. The lot size shall be [ ] square yards (square meters). Smoothness measurements shall be made at 50 foot intervals and as determined by the Engineer. In the longitudinal direction, a smoothness reading shall be made at the center of each paving lane. In the transverse direction, smoothness readings shall be made continuously across the full width of the pavement. However, transverse smoothness readings shall not be made across designed grade changes. At warped transition areas, straightedge

position shall be adjusted to measure surface smoothness and not design grade transitions. When more than 15 percent of all measurements within a lot exceed the specified tolerance, the Contractor shall remove the deficient area to the depth of the final course of pavement and replace with new material. Skin patching shall not be permitted. Isolated high points may be ground off providing the course thickness complies with the thickness specified on the plans. High point grinding will be limited to 15 square yards. Areas in excess of 15 square yards will require removal and replacement of the pavement in accordance with the limitations noted above.

* *

The Engineer shall specify the lot size. A minimum of 2,000 square yards (1 650 square meters) is recommended.

Use of a profilograph can be included in the specifications for surface smoothness for runways and taxiways on a case by case basis provided it is approved by the FAA. Use of a profilograph may not be practical for all asphalt construction. Thin lift overlays and other minimum resurfacing may not allow for removal of existing pavement roughness. However, the use of the profilograph is recommended for new construction or overlays designed to correct grade and smoothness deficiencies. If the profilograph is to be included, straightedge requirements need only apply to the perpendicular direction. To include profilograph requirements, add ASTM E 1274 to the referenced testing list and add the following:

> ***(a) Profilograph. The Contractor shall furnish a 25 foot wheel base California type profilograph and competent operator to measure pavement surface deviations. The profilograph shall be operated in accordance with the manufacturer's instructions and at a speed no greater than 3 mph. Original profilograms for the appropriate locations interpreted in accordance with ASTM E 1274 shall be furnished to the Engineer. The profilograms shall be recorded on a scale of one inch equal to 25 feet longitudinally and one inch equal to one inch (or full scale) vertically. Profilographs shall be calibrated prior to testing.***
>
> ***The surface of the runway and/or taxiway pavements of continuous placement of 50 feet or more shall be tested and evaluated as described herein. One pass along the centerline shall be required for each paving lane. Runs shall be continuous through a day's production. Each trace shall be completely labeled to show paving lane and stationing.***
>
> ***The Contractor shall furnish paving equipment and employ methods that produce a riding surface for each section of pavement having an average profile index meeting the requirements of Table 7. A typical section will be considered to be the width of the paving lane and 1/10 of a mile long. The profile index will be determined in accordance with ASTM E 1274. A blanking band of 0.2 inches shall be used. Within each 1/10 mile section, all areas represented by high points having a deviation in excess of 0.4 inches in 25 feet or less shall be removed by the Contractor using an approved method. After removing all individual deviations in excess of 0.4 inches, additional corrective work shall be performed if necessary to achieve the required ride quality. All corrective work shall be completed prior to determination of pavement thickness.***

On pavement sections where corrections were necessary, second profilograph runs shall be performed to verify that the corrections have produced an average profile index of 15 inches per mile or less. If the initial average profile index was less than 15, only those areas representing greater than 0.4 inch deviation will be re-profiled for correction verification.

Individual sections shorter than 50 feet and the last 15 feet of any section where the Contractor is not responsible for the adjoining section, shall be straightedged in accordance with paragraph 401-5.2b(5).

If there is a section of 250 feet or less, the profilogram for the section shall be included in the evaluation of the previous section. If there is an independently placed section of 50 to 250 feet in length, a profilogram shall be made for that section and the pay adjustment factors for short section of Table 7 shall apply.

All costs necessary to provide the profilograph and related to furnishing the appropriate profilograms as required in this provision are incidental to pavement construction and no direct compensation will be made therefore.

* *

(6) Grade. The finished surface of the pavement shall not vary from the gradeline elevations and cross sections shown on the plans by more than ½ inch (12.70 mm). The finished grade of each lot will be determined by running levels at intervals of 50 feet (15.2 m) or less longitudinally and transversely to determine the elevation of the completed pavement. The Contractor shall pay the cost of surveying of the level runs which shall be performed by a licensed surveyor. The documentation, stamped and signed by a licensed surveyor, shall be provided by the Contractor to the Engineer. The lot size shall be [ ] square yards (square meters). When more than 15 percent of all the measurements within a lot are outside the specified tolerance, or if any one shot within the lot deviates 3/4 inch or more from planned grade, the Contractor shall remove the deficient area to the depth of the final course of pavement and replace with new material. Skin patching shall not be permitted. Isolated high points may be ground off providing the course thickness complies with the thickness specified on the plans. High point grinding will be limited to 15 square yards. Areas in excess of 15 square yards will require removal and replacement of the pavement in accordance with the limitations noted above.

* *

A minimum of 2,000 square yards (1 650 square meters) is recommended.

* *

[(7) Absence of Ponding. The final surface of the pavement shall not demonstrate ponding of water. At completion of paving of the final surface course, the Contractor shall thoroughly cover the pavement with water using a water distribution vehicle. In areas that do not adequately drain the water from the surface, or otherwise hold water, the Contractor, at his expense, shall remove the deficient area to the depth of the final course of pavement and replace with new material. Skin patching shall not be permitted. Isolated high points may be ground off providing the course thickness complies with the thickness specified on the plans. High point grinding will be limited to 15 square yards. Areas in excess of 15 square yards will require removal and replacement of the pavement in accordance with the limitations noted above.**]**

* *

Engineer may retain the language in brackets to include acceptance testing based on the absence of ponding. In some pavement rehabilitations, extensions and other pavement work, design grades may be nearly flat as to do otherwise might be impractical or too costly. In such cases, the bracketed text should be deleted along with the bracketed text in paragraphs 401-5.2a and 401-6.3.

* *

c. Percentage of Material Within Specification Limits (PWL). The percentage of material within specification limits (PWL) shall be determined in accordance with procedures specified in Section 110 of the General Provisions. The specification tolerance limits (L) for lower and (U) for upper are contained in Table 5.

* *

The specification tolerance limits applicable to the project, based on design criteria specified in Table 1, shall be specified by the Engineer from the information shown below and inserted into Table 5. Asterisks denote insert points.

TABLE 5. MARSHALL ACCEPTANCE LIMITS FOR STABILITY, FLOW, AIR VOIDS, DENSITY

TEST PROPERTY	***Pavements Designed for Aircraft Gross Weights of 60,000 Lbs. or More or Tire Pressure of 100 Psi or More***		***Pavements Designed for Aircraft Gross Weight Less Than 60,000 Lbs. or Tire Pressure Less Than 100 Psi***	
	SURFACE COURSE			
Number of Blows	***75***		***50***	
	Specification Tolerance Limits		***Specification Tolerance Limits***	
	L	***U***	***L***	***U***
Stability, minimum, pounds	***1800***	***--***	***1000***	***--***
Flow, 0.01-inch	***8***	***16***	***8***	***20***
Air Voids Total Mix, percent	***2***	***5***	***2***	***5***
Surface Course Mat Density, percent	***96.3***	***–***	***96.3***	***–***
Base Course Mat Density, percent	***95.3***	***–***	***95.3***	***–***
Surface and Base Course Joint density, percent	***93.3***	***–***	***93.3***	***–***

* *

TABLE 5. MARSHALL ACCEPTANCE LIMITS FOR STABILITY, FLOW, AIR VOIDS, DENSITY

TEST PROPERTY	***SURFACE COURSE***
Number of Blows	***
	Specification Tolerance

	L	*U*
Stability, minimum, pounds	*	*
Flow, 0.01-inch	*	*
Air Voids Total Mix, percent	*	*
Surface Course Mat Density, percent	*	*
Base Course Mat Density, percent	*	*
Joint Density, percent	*	*

The criteria in Table 5 is based on production processes which have a variability with the following standard deviations:

Surface Course Mat Density (%), 1.3
Base Course Mat Density (%), 1.7
Joint Density (%), 2.1

* *

A lot is the quantity of material to be controlled and may represent a specified tonnage or a specified number of truckloads. The lot size, to be determined by the Engineer, should, for the most part, depend on the operational capacity of the plant, but shall in no case exceed 2,000 tons (1 814 000 kg) in accordance with paragraph 401-5.1a.

* *

401-5.3 RESAMPLING PAVEMENT FOR MAT DENSITY.

a. General. Resampling of a lot of pavement *will only be allowed* for mat density*, and then, only* if the Contractor requests *same*, in writing, within 48 hours after receiving the written test results from the Engineer. A retest will consist of all the sampling and testing procedures contained in paragraphs 401-5.1b and *401-5.2b(1)*. Only one resampling per lot will be permitted.

(1) A redefined PWL shall be calculated for the resampled lot. The number of tests used to calculate the redefined PWL shall include the initial tests made for that lot plus the retests.

(2) The cost for resampling and retesting shall be borne by the Contractor.

b. Payment for Resampled Lots. The redefined PWL for a resampled lot shall be used to calculate the payment for that lot in accordance with Table 6.

c. Outliers. If the tests within a lot include a very large or a very small value which appears to be outside the normal limits of variation, check for an outlier in accordance with ASTM E 178, at a significance level of 5 percent, to determine if this value should be discarded when computing the PWL.

[401-5.4 LEVELING COURSE. Any course used for truing and leveling shall meet the requirements of paragraph 401-3.2, *401-5.2b(1) for air voids and 401-5.2b(2)*, but shall not be subject to the density requirements of paragraph *401-5.2b(1) for mat density and 401-5.2b(3)* The leveling course shall be compacted with the same effort used to achieve density of the test section. The truing and leveling course shall not exceed a nominal thickness of 1-1/2 inches (37.5 mm).] *The leveling course is the first variable thickness lift of an overlay placed prior to subsequent courses.***]**

* *

* * * * * **Use this paragraph only when there is a need to restore proper cross-section prior to overlaying. Areas of the pavement requiring a leveling course shall be shown on the plans.**

* *

Contractor QUALITY CONTROL

401-6.1 GENERAL. The Contractor shall develop a Quality Control Program in accordance with Section 100 of the General Provisions. The program shall address all elements which effect the quality of the pavement including, but not limited to:

a. Mix Design	**f.** Mixing and Transportation
b. Aggregate Grading	**g.** Placing and Finishing
c. Quality of Materials	**h.** Joints
d. Stockpile Management	**i.** Compaction
e. Proportioning	**j.** Surface smoothness
	k. Personnel

The Contractor shall perform quality control sampling, testing, and inspection during all phases of the work and shall perform them at a rate sufficient to ensure that the work conforms to the contract requirements, and at minimum test frequencies required by paragraph 401-6.3 and Section 100 of the General Provisions. As a part of the process for approving the Contractor's plan, the Engineer may require the Contractor's technician to perform testing of samples to demonstrate an acceptable level of performance.

No partial payment will be made for materials that are subject to specific quality control requirements without an approved plan.

401-6.2 TESTING LABORATORY. The Contractor shall provide a fully equipped asphalt laboratory meeting the requirements of paragraph 401-3.5 and 401-4.2a(2) located at the plant or job site. The Contractor shall provide the Engineer with certification stating that all of the testing equipment to be used is properly calibrated and will meet the specifications applicable for the specified test procedures.

401-6.3 QUALITY CONTROL TESTING. The Contractor shall perform all quality control tests necessary to control the production and construction processes applicable to these specifications and as set forth in the approved Quality Control Program. The testing program shall include, but not necessarily limited to, tests for the control of asphalt content, aggregate gradation, temperatures, aggregate moisture, field compaction, **[the absence of ponding,]** and surface smoothness. A Quality Control Testing Plan shall be developed as part of the Quality Control Program.

* *

See note to Engineer in section 401-5.2b(7) regarding acceptance testing based on the absense of ponding.

* *

a. Asphalt Content. A minimum of two extraction tests shall be performed per lot in accordance with ASTM D 2172 for determination of asphalt content. The weight of ash portion of the extraction test, as described in ASTM D 2172, shall be determined as part of the first extraction test performed at the beginning of plant production; and as part of every tenth extraction test performed thereafter, for the duration of plant production. The last weight of ash value obtained shall be used in the calculation of the asphalt content for the mixture. The asphalt content for the lot will be determined by averaging the test results.

The use of the nuclear method for determining asphalt content in accordance with ASTM D 4125 is permitted, provided that it is calibrated for the specific mix being used.

b. Gradation. Aggregate gradations shall be determined a minimum of twice per lot from mechanical analysis of extracted aggregate in accordance with AASHTO T 30 and ASTM C 136 (Dry Sieve). When asphalt content is determined by the nuclear method, aggregate gradation shall be determined from hot bin samples on batch plants, or from the cold feed on drum mix or continuous mix plants, and tested in accordance with ASTM C 136 (dry sieve) using actual batch weights to determine the combined aggregate gradation of the mixture.

c. Moisture Content of Aggregate. The moisture content of aggregate used for production shall be determined a minimum of once per lot in accordance with ASTM C 566.

d. Moisture Content of Mixture. The moisture content of the mixture shall be determined once per lot in accordance with ASTM D 1461 ***[or AASHTO T110]***.

* *

ASTM D 1461 may be replaced with AASHTO T110 moisture content testing procedure using a conventional oven or microwave.

* *

e. Temperatures. Temperatures shall be checked, at least four times per lot, at necessary locations to determine the temperatures of the dryer, the bitumen in the storage tank, the mixture at the plant, and the mixture at the job site.

f. In-Place Density Monitoring. The Contractor shall conduct any necessary testing to ensure that the specified density is being achieved. A nuclear gauge may be used to monitor the pavement density in accordance with ASTM D 2950.

g. Additional Testing. Any additional testing that the Contractor deems necessary to control the process may be performed at the Contractor's option.

h. Monitoring. The Engineer reserves the right to monitor any or all of the above testing.

401-6.4 SAMPLING. When directed by the Engineer, the Contractor shall sample and test any material which appears inconsistent with similar material being sampled, unless such material is voluntarily removed and replaced or deficiencies corrected by the Contractor. All sampling shall be in accordance with standard procedures specified.

401-6.5 CONTROL CHARTS. The Contractor shall maintain linear control charts both for individual measurements and range (i.e., difference between highest and lowest measurements) for aggregate gradation and asphalt content.

Control charts shall be posted in a location satisfactory to the Engineer and shall be kept current. As a minimum, the control charts shall identify the project number, the contract item number, the test number, each test parameter, the Action and Suspension Limits applicable to each test parameter, and the Contractor's test results. The Contractor shall use the control charts as part of a process control system for identifying potential problems and assignable

causes before they occur. If the Contractor's projected data during production indicates a problem and the Contractor is not taking satisfactory corrective action, the Engineer may suspend production or acceptance of the material.

a. Individual Measurements. Control charts for individual measurements shall be established to maintain process control within tolerance for aggregate gradation and asphalt content. The control charts shall use the job mix formula target values as indicators of central tendency for the following test parameters with associated Action and Suspension Limits:

CONTROL CHART LIMITS FOR INDIVIDUAL MEASUREMENTS

Sieve	Action Limit	Suspension Limit
1 inch (25.0 mm)	0%	0%
3/4 inch (19.0 mm)	+/-6%	+/-9%
1/2 inch (12.5 mm)	+/-6%	+/-9%
3/8 inch (9.5 mm)	+/-6%	+/-9%
No. 4 (4.75 mm)	+/-6%	+/-9%
No. 16 (1.18 mm)	+/-5%	+/-7.5%
No. 50 (0.30 mm)	+/-3%	+/-4.5%
No. 200 (0.075 mm)	+/-2%	+/-3%
Asphalt Content	+/-0.45%	+/-0.70%

b. Range. Control charts for range shall be established to control process variability for the test parameters and Suspension Limits listed below. The range shall be computed for each lot as the difference between the two test results for each control parameter. The Suspension Limits specified below are based on a sample size of n = 2. Should the Contractor elect to perform more than two tests per lot, the Suspension Limits shall be adjusted by multiplying the Suspension Limit by 1.18 for n = 3 and by 1.27 for n = 4.

CONTROL CHART LIMITS BASED ON RANGE
(Based on n = 2)

Sieve	Suspension Limit
½ inch (12.5 mm)	11 percent
3/8 inch (9.5 mm)	11 percent
No. 4 (4.75 mm)	11 percent
No. 16 (1.18 mm)	9 percent
No. 50 (0.30 mm)	6 percent
No. 200 (0.075 mm)	3.5 percent
Asphalt Content	0.8 percent

c. Corrective Action. The Quality Control Plan shall indicate that appropriate action shall be taken when the process is believed to be out of tolerance. The Plan shall contain sets of rules to gauge when a process is out of control and detail what action will be taken to bring the process into control. As a minimum, a process shall be deemed out of control and production stopped and corrective action taken, if:

(1) One point falls outside the Suspension Limit line for individual measurements or range; or

(2) Two points in a row fall outside the Action Limit line for individual measurements.

* *

The aggregate control chart parameters and Suspension and Action Limits contained in the above paragraphs are based on 3/4 inch (19.0 mm) maximum size aggregate gradation. When 1-inch (25.0 mm) maximum size aggregate is specified, the Individual Measurements Chart requirements should be amended as follows:

Sieve	Action Limit	Suspension Limit
3/4 inch	6%	11%

When ½-inch (12.5 mm) maximum size aggregate is specified, the 3/4-inch (19.0 mm) and 1-inch (25.0 mm) sieves should be deleted from the Individual Measurements Chart and the ½-inch (12.5 mm) sieve Action and Suspension Limits should be changed to 0%. For the ½-inch (12.5 mm) gradation, the ½-inch sieve should be deleted from the Range Chart.

* *

401-6.6 QUALITY CONTROL REPORTS. The Contractor shall maintain records and shall submit reports of quality control activities daily, in accordance with the Quality Control Plan described in General Provisions, Section 100.

METHOD OF MEASUREMENT

401-7.1 MEASUREMENT. Plant mix bituminous concrete pavement shall be measured by the number of tons (kg) of bituminous mixture **[**and the number of tons (kg) of bituminous material used in the accepted work. Recorded batch weights or truck scale weights will be used to determine the basis for the tonnage.

Saw-cut grooving of bituminous pavement shall be measured by the number of square yards of saw-cut grooving as specified in-place, completed and accepted.

BASIS OF PAYMENT

401-8.1 PAYMENT. Payment for an accepted lot of bituminous concrete pavement shall be made at the contract unit price per ton (kg) for bituminous mixture adjusted according to paragraph 401-8.1a, subject to the limitation that:

> The total project payment for plant mix bituminous concrete pavement shall not exceed **[ ]** percent of the product of the contract unit price and the total number of tons (kg) of bituminous mixture **[**, and **[ ]** percent of the product of the contract unit price and the number of tons (kg) of bituminous material**]** used in the accepted work (See Note 2 under Table 6).

Payment for accepted saw-cut grooving shall be made at the contract unit price per square yard.

The price shall be compensation for furnishing all materials, for all preparation, mixing, and placing of these materials, and for all labor, equipment, tools, and incidentals necessary to complete the item.

* *

The Engineer shall specify a value ranging from 100 to 106 percent. When the total project payment for Item P-401 pavement exceeds the contract unit price, any AIP or PFC funds used to pay the excess may require an amendment to the AIP grant or PFC application for the project.

* *

a. Basis of Adjusted Payment. The pay factor for each individual lot shall be calculated in accordance with Table 6. A pay factor shall be calculated for both mat density and air voids. The lot pay factor shall be the higher of the two values when calculations for both mat density and air voids are 100 percent or higher. The lot pay factor shall be the product of the two values when only one of the calculations for either mat density or air voids is 100 percent or higher. The lot pay factor shall be the lower of the two values when calculations for both mat density and air voids are less than 100 percent. . *The lot pay factor shall be reduced as necessary per paragraph 401-5.2b(3) Joint Density.* [The lot pay factor shall apply to both the bituminous mixture and the bituminous material**.]**

TABLE 6. PRICE ADJUSTMENT SCHEDULE [1]

Percentage of Material Within Specification Limits (PWL)	**Lot Pay Factor (Percent of Contract Unit Price)**
96 – 100	106
90 – 95	PWL + 10
75 – 89	0.5 PWL + 55
55 – 74	1.4PWL – 12
Below 55	Reject [2]

TABLE 6. PRICE ADJUSTMENT SCHEDULE [1]

[1] Although it is theoretically possible to achieve a pay factor of 106 percent for each lot, actual payment above 100 percent shall be subject to the total project payment limitation specified in paragraph 401-8.1.

[2] The lot shall be removed and replaced. However, the Engineer may decide to allow the rejected lot to remain. In that case, if the Engineer and Contractor agree in writing that the lot shall not be removed, it shall be paid for at 50 percent of the contract unit price and the total project payment limitation shall be reduced by the amount withheld for the rejected lot.

For each lot accepted, the adjusted contract unit price shall be the lot pay factor for the lot multiplied by the contract unit price. Payment shall be subject to the total project payment limitation specified in paragraph ***401-8.1*** Payment in excess of 100 percent for accepted lots of bituminous concrete pavement shall be used to offset payment for accepted lots of bituminous concrete pavement that achieve a lot pay factor less than 100 percent.

* *

If a profilograph is used, add the following paragraphs and change existing paragraph 401-8.1b to 401-8.1d (The pay adjustment in Table 7 is optional to the Owner and Engineer when using the profilograph):

b. When the final average profile index (subsequent to any required corrective action) does not exceed 7 inches per mile, payment will be made for that section at the contract unit price for the completed pavement. If the final average profile index (subsequent to any required corrective action) exceeds7 inches per mile, but does not exceed 15 inches per mile, the Contractor may elect to accept a contract unit price adjustment in lieu of reducing the profile index.

c. Basis of Adjusted Payment for Smoothness. Price adjustment for pavement smoothness will be made in accordance with Table 7. The

adjustment will apply to the total tonnage of asphalt concrete within a lot of pavement and shall be applied with the following equation:

(Tons of asphalt concrete in lot) x (lot pay factor) x (unit price per ton) x (smoothness pay factor) = payment for lot

Table 7
Average Profile Index Smoothness Pay Factor

(Inches per mile per 1/10 mile)	*Short Sections*	*Pay Factor*
00.0 - 7	*00.0 - 15.0*	*100%*
7.1 - 9	*15.1 - 16*	*98%*
9.1 - 11	*16.1 - 17*	*96%*
11.1 - 13	*17.1 - 18*	*94%*
13.1 - 14	*18.1 - 20*	*92%*
14.1 - 15	*20.1 - 22*	*90%*
15.1 & up	*22.1& up*	*corrective work required*[1]

[1]The Contractor shall correct pavement areas not meeting these tolerances by removing and replacing the defective work. If the Contractor elects to construct an overlay to correct deficiencies, the minimum thickness of the overlay shall not be less than twice the size of the maximum size aggregate. The corrective overlay shall not violate grade criteria and butt joints shall be constructed by sawing and removing the original pavement in compliance with the thickness/maximum aggregate size ratio. Skin patching shall not be permitted.

Unit bid price adjustment will apply to total bituminous mixture and asphalt cement quantities within the 1/10 mile segment of pavement. Deductions will be applied to recorded project quantities. Any pavement section less than 1/10 mile will be accepted on a pro-rated basis.

Material used in building the pavement above the specified grade shall not be included in the quantities for payment.

* *

b. Payment. Payment will be made under:

Item P-401-8.1a Bituminous ***Surface Course*** — per ton (kg)

[Item P-401-8.1b Bituminous Material — per ton (kg)]

[Item P-401-8.1b Grooving -- per square yard]

TESTING REQUIREMENTS

ASTM C 29	Bulk Density (“Unit Weight”) and voids in Aggregate
ASTM C 88	Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 117	Materials Finer than 75-um (No.200) Sieve in Mineral Aggregates by Washing
ASTM C 127	Specific Gravity and Absorption of Coarse Aggregate
ASTM C 131	Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C 183	Sampling and the Amount of Testing of Hydraulic Cement
ASTM C 566	Total Evaporable Moisture Content of Aggregate by Drying
ASTM D 75	Sampling Aggregates
ASTM D 979	Sampling Bituminous Paving Mixtures
ASTM D 995	Mixing Plants for Hot-Mixed Hot-Laid Bituminous Paving Mixtures
ASTM D 1073	Fine Aggregate for Bituminous Paving Mixtures
ASTM D 1074	Compressive Strength of Bituminous Mixtures
ASTM D 1188	Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Paraffin-Coated Specimens
ASTM D 1461	Moisture or Volatile Distillates in Bituminous Paving Mixtures
ASTM D 1559	Resistance to Plastic Flow of Bituminous Mixtures Using Marshall Apparatus
ASTM D 2041	Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures
ASTM D 2172	Quantitative Extraction of Bitumen from Bituminous Paving Mixtures
ASTM D 2419	Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2489	Degree of Particle Coating of Bituminous-Aggregate Mixtures
ASTM D 2726	Bulk Specific Gravity and Density of Non-Absorptive Compacted Bituminous Mixtures
ASTM D 2950	Density of Bituminous Concrete in Place by Nuclear Methods

ASTM D 3203	Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures
ASTM D 3665	Random Sampling of Construction Materials
ASTM D 3666	Minimum Requirements for Agencies Testing and Inspecting Bituminous Paving Materials
ASTM D 4125	Asphalt Content of Bituminous Mixtures by the Nuclear Method
ASTM D 4318	Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4791	Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate
ASTM D 4867	Effect of Moisture on Asphalt Concrete Paving Mixtures
ASTM E 11	Wire-Cloth Sieves for Testing Purposes
ASTM E 178	Dealing With Outlying Observations
ASTM E 1274	Measuring Pavement Roughness Using a Profilograph
AASHTO T 30	Mechanical Analysis of Extracted Aggregate
AASHTO T 110	Moisture or Volatile Distillates in Bitumnous Paving Mixtures
The Asphalt Institute's Manual No. 2 (MS-2)	Mix Design Methods for Asphalt Concrete
The Asphalt Institute's Manual No. 20 (MS-20)	Asphalt Hot-Mix Recycling

MATERIAL REQUIREMENTS

ASTM D 242	Mineral Filler for Bituminous Paving Mixtures
ASTM D 946	Penetration Graded Asphalt Cement for Use in Pavement Construction
ASTM D 3381	Viscosity-Graded Asphalt Cement for Use in Pavement Construction
ASTM D 4552	Classifying Hot-Mix Recycling Agents

END OF ITEM P-401